

**1.0 DESCRIPTION**

Design, prepare plans, and construct MSE retaining walls to the lines, grades and locations shown in the plans and in accordance with this specification and the details shown in the plans. Work includes all excavation, leveling pad, concrete face panel, concrete coping, retaining wall backfill, the fabric above the crushed aggregate backfill, and all other materials, labor, tools, equipment and incidentals necessary to complete the work.

Furnish any one of following retaining wall systems or approved equal in accordance with this Special Provision. Declare the choice of retaining wall system at the first Project Preconstruction Conference for the project. The wall system chosen at this Preconstruction Conference becomes the required wall system for the contract.

The Reinforced Earth Wall as manufactured by:

The Reinforced Earth Company  
8614 Westwood Center Drive, Suite 1100  
Vienna, VA 22182  
Telephone (703) 821-1175

The Retained Earth Wall as manufactured by:

Foster Geotechnical  
1372 Old Bridge Road, Suite 101  
Woodbridge, VA 22192  
Telephone (703) 499-9818

The Reinforced Soil Embankment Wall as manufactured by:

T and B Structural Systems  
637 W. Hurst Boulevard, Suite 2A  
Hurst, TX 76053  
Telephone (817) 280-9858

The MSE Plus Wall as manufactured by:

SSL, Inc.  
4740 Scotts Valley Drive, Suite E  
Scotts Valley, CA 95066  
Telephone (831) 430-9300

The Tricon Retained Soil Wall as manufactured by:

Tricon Precast Ltd.  
15055 Henry Road  
Houston, TX 77060  
Telephone (281) 931-9832

The approved equal must meet the following criteria:

1. The MSE Retaining Wall System must utilize precast concrete face panels, and utilize steel soil reinforcements with a positive connection to the panels. Full-height panels are not allowed.
2. The company marketing the system must have successfully completed at least three projects in the last three years involving construction of permanent MSE walls totaling at least 100,000 square feet (10,000 square meters) of wall face area. Submit experience qualifications and details for these projects including owner contact information.
3. All other aspects of this special provision apply to the design, manufacture and construction of this MSE wall system.

Allow 15 calendar days review for approved equal.

Value engineering proposals for other wall systems are not considered.

Design the retaining walls to meet the criteria of the current AASHTO Standard Specifications for Highway Bridges and the requirements specified in the plans.

Submit eight sets of complete working drawings/shop plans, erection plans and design calculations, sealed by a North Carolina Registered Professional Engineer, for review and approval prior to beginning wall work. Allow 40 days for review and approval from the date they are received by the Engineer until they are returned to the Contractor.

Provide the option chosen to meet the requirements of the plans, this Special Provision and the Standard Specifications.

## **2.0 GENERAL**

The Resident Engineer schedules a Preconstruction Conference with representatives from the Contractor, the retaining wall system Supplier, the Geotechnical Engineering Unit, and the Chemical Testing Section of the Materials and Tests Unit to discuss construction details and inspection of the retaining wall.

Provide all necessary material from the Supplier chosen.

Obtain from the Supplier technical instruction and guidance in preconstruction activities, including the Preconstruction Conference, and on-site technical assistance during construction. Follow any instructions from the Supplier closely unless otherwise directed.

### **3.0 MATERIALS**

#### **A. Concrete Panels**

Provide the concrete mix designed by the Supplier to the State Materials Engineer prior to use. Design the mix to meet the strength requirements included in this Special Provision under the heading "Casting of Precast Concrete Face Panels".

#### **B. Concrete Leveling Pad**

Provide Class A concrete conforming to the applicable requirements in Sections 420 and 1000 of the Standard Specifications for the leveling pad.

#### **C. Concrete Coping**

Use Class A Concrete for coping and apply the requirements in Sections 420, 1000, and 1077 of the Standard Specifications. The requirements in Sections 425 and 1070 of the Standard Specifications apply to the reinforcing steel in coping. If preferred, precast coping is permitted unless otherwise stated in the plans.

#### **D. Wall Facing Panel Reinforcing Steel, Soil Reinforcing Mesh, Mats, or Strips**

Use reinforcing steel conforming to the applicable requirements in Sections 425 and 1070 of the Standard Specifications.

Shop fabricate the soil reinforcing mesh or mats of cold drawn steel wire conforming to the minimum requirements of AASHTO M32 (M32M) and weld into the finished mesh fabric in accordance with AASHTO M55 (M55M). Hot roll reinforcing strips from bars to the required shape and dimensions with their physical and mechanical properties conforming to AASHTO M223 (M223M), Grade 65 (Grade 450). Cut to lengths and tolerances shown on the plans and punch holes for bolts in the locations shown on plan details. Inspect all reinforcing and tie strips carefully to ensure they are true to size and free from defects that may impair their strength or durability. Galvanize in accordance with the minimum requirements of AASHTO M111.

#### **E. Miscellaneous Panel Components and Attachment Devices**

Provide miscellaneous concrete face panel components, including dowels, polyvinylchloride pipe, stirrups, etc., in accordance with the Supplier's recommendations.

Shop-fabricate tie strips of hot rolled steel conforming to the minimum requirements of ASTM A1011, Grade 50 (Grade 345) or equivalent. The minimum bending radius of tie strips is 1 inch (25 mm).

Use 1/2" (12.70 mm) diameter bolts, nuts and washers conforming to AASHTO M164 (M164M). Provide Bolt and thread lengths in accordance with the Supplier's

recommendations. Hot-dip galvanize bolts and nuts in accordance with the requirements of AASHTO M232 (M232M).

Fabricate clevis connector and connector bar from cold drawn steel wire conforming to the requirements of AASHTO M32 (M32M) and weld in accordance with AASHTO M55 (M55M). Galvanize loops in accordance with AASHTO M111.

#### F. Joints and Joint Materials

Provide the type and grade bearing pads approved by the chosen Supplier.

Where shown on the plans, provide a polyester filter fabric cover, approved by the Supplier, for horizontal and vertical joints between panels. Use adhesive approved by the manufacturer to attach the fabric material to the rear of the facing panels.

#### G. Alignment Pins

Use 5/8" (16 mm) diameter, smooth mild steel bars galvanized in accordance with AASHTO M111 for pins to align the face panels during construction.

#### H. Coarse Aggregate Backfill (Retaining Wall)

Use only washed, crushed stone backfill material conforming to the applicable requirements for #57, #67, or #78M Stone of Section 1005 and Section 1014-2 of the Standard Specifications and meeting the following criteria:

- Free of organic or otherwise deleterious substances.
- Contains a maximum organic content of 0.1%.
- Electrochemical:      Resistivity > 5000 ohm-cm      ASTM D1125  
   4.5 < pH < 9.5                                      ASTM D1293

Before placing any backfill, furnish a Type IV certification in accordance with Article 106-3 of the Standard Specifications. Include a copy of all test results conducted in accordance with the above requirements in the certification. The Engineer determines how often NCDOT samples backfill material to assure compliance with gradation and electrochemical requirements.

##### 1. Sample Preparation

Obtain approximately 2,000 grams of representative material and transfer it into a 1 gallon (3.8 liters) wide mouth plastic jug. Then add an equal weight of deionized or distilled water to the sample, and let this mixture set for approximately 30 minutes. At the end of this period, place a lid on the container and vigorously agitate the mixture for 3 minutes. Repeat this agitation at the 2 hour and 4 hour intervals. Allow the sample to set for approximately 20 hours after the 4 hour agitation so the solids will settle out. At this time remove a sufficient amount of the

solution and filter through a coarse paper (Fisher Q8) to obtain the supernate to be analyzed in accordance with the above procedures.

## 2. Backfill Separation Fabric

Place a layer of fabric on top of the completed coarse aggregate wall backfill to prevent migration of fines from common backfill placed above from contaminating the wall backfill.

Use fabric meeting the applicable requirements for Type 2 fabric as described in Section 1056 of the Standard Specifications.

Overlap the fabric a minimum of 18 inches (460 mm).

## 4.0 CASTING OF PRECAST CONCRETE FACE PANELS

### A. General

Cast concrete face panels and apply the requirements of Sections 1000 and 1077 of the Standard Specifications.

### B. Acceptance

Supply concrete for precast panels that attains a 28 day compressive strength of 4000 psi (27.6 MPa) unless otherwise shown on plans.

Acceptance of the concrete face panels with respect to compressive strength is determined on the basis of production lots. A production lot is a group of panels that is represented by a single compressive strength sample and consists of either 40 panels or a single day's production, whichever is less. Make compression tests on standard 6" x 12" (152 mm by 305 mm) or 4" x 8" (102 mm by 203 mm) test specimens prepared in accordance with AASHTO T23. Conduct compressive strength testing in accordance with AASHTO T22.

Cast a minimum of four cylinders for each production lot sampled. Cure all specimens in the same manner as the panels. An acceptance test result is the average compressive strength of two cylinders.

The lot is acceptable if the test results are equal to or greater than 4000 psi (27.6 MPa).

If a production lot fails to meet the specified compressive strength requirements, the production lot is rejected unless the Supplier, at his own expense, obtains and submits evidence of a type acceptable to the Engineer that the strength and quality of the concrete placed within the panels of the production lot is acceptable. If such evidence consists of tests made on cores taken from the panels within the production lot, obtain and test the cores in accordance with the requirements of AASHTO T24.

## C. Miscellaneous

### 1. Casting

Set all panel components in place in the forms to conform to the details on the plans and accepted shop plans prior to casting. Cast the panels on a flat area with the front face of the form at the bottom and the rear face at the top. Set tie strip guides or clevis connectors on the rear face.

Give special care to the clevis connectors: Place all clevis connectors normal to the panel and attach them to the alignment templates using the bars provided with the forms. Tolerance for the vertical and horizontal alignment of the clevis connectors is  $\pm 1/8"$  (3 mm). Clean the holes inside the loops so that they are free of all concrete and debris.

Place the concrete in each unit without interruption and consolidate using an approved vibrator, supplemented by hand tamping to force the concrete into corners of the forms and prevent the formation of stone pockets or cleavage planes. Use clear form oil of the same manufacture throughout the casting operation.

### 2. Concrete Finish

Provide an ordinary surface finish as defined by Subarticle 420-18(B) of the Standard Specifications for the front face (exposed face of wall) unless otherwise shown on the plans. Screed the rear face of the panel to a uniform surface finish to eliminate open pockets of aggregate and surface distortions in excess of 1/4 inch (6 mm).

### 3. Tolerances

Manufacture all units within the following tolerances:

- All dimensions within 3/16 inch (5 mm), except the lateral position of the tie strips to within 1 inch (25 mm).
- Surface defects on formed surfaces are not to exceed 1/8 inch in 5 feet (3mm in 1.5 m).

### 4. Marking

Clearly scribe the date of manufacture, the production lot number, and the piece-mark on the rear face of each panel.

### 5. Handling, Storage and Shipping

Handle, store and ship all units in such manner as to eliminate the danger of discoloration, chipping, cracks, fractures and excessive bending stresses. Support panels in storage on firm blocking located immediately adjacent to tie strips to

avoid bending the tie strips. Store panels in a horizontal position and stack no more than six high. Do not ship panels prior to 5 days after production.

## **5.0 CONSTRUCTION METHODS**

### **A. Site Preparation**

Perform surface excavation operations and random fill construction in the vicinity of the structure in accordance with the applicable portions of this Special Provision, and in reasonably close conformity to the lines, grades, dimensions, and cross-sections shown on the plans.

### **B. Retaining Wall Excavation**

Excavate all material necessary for the construction of the retaining walls in accordance with the plans and this provision. Excavation includes the construction and subsequent removal of all necessary bracing, shoring, sheeting and cribbing and all pumping, bailing, and draining. Perform random backfilling in accordance with the details in the plans and dispose of or stockpile surplus or unsuitable excavated material as directed by the Engineer.

Perform all necessary clearing and grubbing at the site in accordance with Section 200 of the Standard Specifications.

Notify the Engineer a sufficient time before beginning the excavation so that measurements may be taken of the undisturbed ground.

Shore or brace the excavation in accordance with local and state safety standards. Perform excavation and related work in such sequence that no portion of the retaining wall will be endangered by subsequent operations.

When the retaining wall is adjacent to a traveled way, obtain approval before beginning the excavation. Submit drawings and design calculations for shoring in accordance with the provisions of Subarticle 410-5(D) of the Standard Specifications.

Notify the Engineer after excavating each location of the wall. Do not place the concrete leveling pad until the depth of the excavation and the character of the foundation material have been approved.

Remove all sheeting and bracing as the random backfilling progresses.

Obtain approval for all random backfill material. Large or frozen lumps, wood or other undesirable material is not allowed in the backfill. Compact all backfill in accordance with Subarticle 235-4(C) of the Standard Specifications.

### **C. Wall Erection**

#### **1. Foundation Preparation**

Prior to wall construction, grade the foundation for the structure level for a width equal to or exceeding the length of soil reinforcing or as shown on the plans. Compact the foundation to a minimum of 95% of the maximum dry density as determined by AASHTO T99.

## 2. Leveling Pad Construction

Construct an unreinforced concrete leveling pad of Class A concrete having the dimensions and at the locations and elevations shown on the plans. Cure the leveling pad a minimum of 24 hours before placement of wall panels.

## 3. Placing Concrete Face Panels

Place precast concrete panels vertically with equipment that does not damage the panels. For erection, handle panels by means of eyes set into the upper edge of the panels. Use other placement methods when approved by the Supplier and Engineer. Place panels in successive horizontal lifts in accordance with the details and at the locations shown on the plans. Externally brace the first lift of panels. Proceed with backfill placement as hereinafter specified. As panel and backfill lifts progress, maintain the panels in vertical position by means of temporary wooden wedges placed in the joint at the junction of the two adjacent panels on the external side of the wall. The maximum tolerance for vertical (plumbness) and horizontal alignment is 3/4 inch (19 mm) when measured along a 10 foot (3 m) straightedge. The maximum allowable offset in any panel joint is 3/4 inch (19 mm). The overall vertical tolerance of the wall (plumbness from top to bottom) is 1/2 inch (13 mm) per 10 feet (3 m) of wall height. As wall erection progresses, install horizontal and vertical joint filler in accordance with the Supplier's instructions.

## 4. Placing Retaining Wall Backfill and Soil Reinforcing

Place backfill within the structure closely following the erection of each lift of panels. Place the backfill material in layers for the full width shown on the plans. Place layers not more than 7½ inches (190 mm) in depth loose thickness and compact. Compact coarse aggregate backfill with at least four passes of an 8 – 10 ton (7.3 - 9.1 metric ton) vibratory roller in the vibratory mode, or as directed by the Engineer. At each soil reinforcement location, level and compact the backfill material before placing and attaching tie strip, mat or mesh. Place the soil reinforcement normal to the face of the wall or as shown on the plans. Compact backfill layers in a direction parallel to the wall and without disturbance or distortion of soil reinforcement or wall panels. Use only a hand-operated mechanical compactor within 3 feet (1 m) of the face of the wall as a precaution against pushing panels outward and distorting the vertical face of the wall. Exercise extreme care to prevent bending soil reinforcement or panel attachments during compaction. Compact as required with a minimum of three passes of the hand-operated compactor.



At the end of each day's operation, slope the areas adjacent to the stone backfill such that in the event of rain, surface runoff will be diverted away from the backfill area. Contamination of the stone backfill by soil fines from runoff is grounds for rejection of the backfill.

5. Placing Concrete Coping

When cast-in-place coping is used, place a 1/2 inch deep vertical contraction joint in all exposed faces at a spacing equal to two panel widths and in accordance with Article 825-10(B) of the Standard Specifications. Place the contraction joints in the coping so that it aligns with the vertical joints between the panels.

**6.0 BASIS OF PAYMENT**

Payment will be made under:

MSE Retaining Walls, Sta. \_\_\_\_\_ Lump Sum